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Adaptive PI Control of STATCOM

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ABSTRACT-STATCOM or Static Synchronous Compensator is a shunt gadget, which utilizes force-commutated power electronics (i.e. GTO, GCT) gate commutated turn-off (GCT) thyristors and an interconnecting transformer in control framework. It is additionally an individual from Flexible AC Transmission System (FACTS) gadgets and has quicker operation. STATCOMs are regularly connected in long separation transmission frameworks, control substations and overwhelming ventures where voltage dependability is the essential concern. Truths gadgets give a chance to determine clogs by controlling dynamic and responsive power streams and in addition voltages. Certainities gadgets can be associated with a transmission line in different courses, for example, in arrangement, shunt, or a mix of arrangement and shunt. STATCOM is utilized for receptive power pay on electric transmission line. It can go about as either a source or sink of responsive AC energy to a power arrange. The STATCOM have low working misfortunes, characteristically low consonant era, and a secluded structure that guarantees high accessibility and simplicity of assembling. In this paper, new control show is actualized utilizing versatile PI control. Amid unsettling influence control pick up can act naturally balanced by versatile PI control so that coveted execution can accomplished. Versatile PI control indicates magnificent execution amid unsettling influence.

KEYWORDS: Static Synchronous Compensator (STATCOM), Gate-turn off (GTO), Flexible AC Transmission System (FACTS), Proportional Integral (PI) Control.

I. INTRODUCTION

The power frameworks today are muddled systems with several producing stations and load focuses being interconnected through power transmission lines. An electric power framework can be subdivided into four phases: i) era, ii) transmission iii) circulation and iv) usage (stack). The essential structure of a power framework is as appeared in Figure. It is made out of creating plants, a transmission framework and conveyance framework. These subsystems are interconnected through transformers T1, T2 and T3.

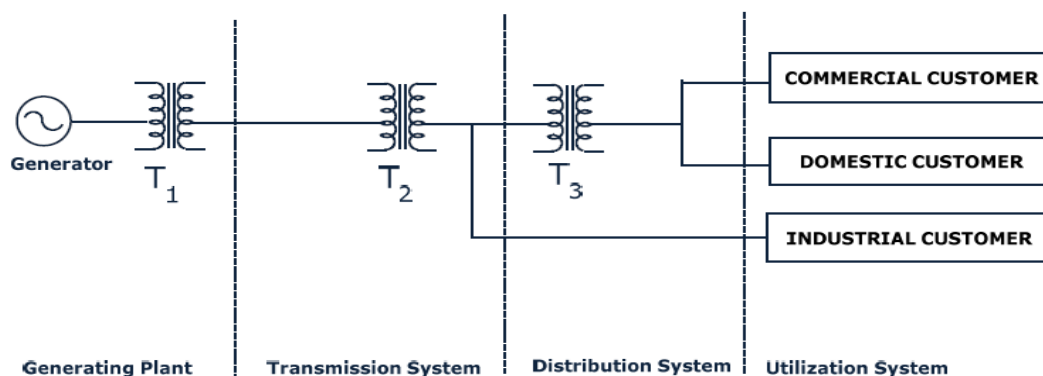


Fig. 1 Typical power systems

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The power framework is an exceedingly nonlinear framework that works in an always showing signs of change condition; loads, generator yields, topology, and key working parameters change persistently. At the point when subjected to a transient aggravation, the soundness of the framework relies on upon the way of the unsettling influence and additionally the underlying working condition. The aggravation might be little or expansive. Little unsettling influences as load changes happen persistently, and the framework acclimates to the evolving conditions. The framework must have the capacity to work attractively under these conditions and effectively take care of the heap demand. It should likewise have the capacity to survive various unsettling influences of an extreme sort, for example, a short out on a transmission line or loss of a vast generator [1]. Presently a-days it is ending up plainly exceptionally hard to completely use the current transmission framework resources because of different reasons, for example, natural enactment, capital speculation, privileges of ways issues, development cost of new lines, deregulation arrangements, and so forth. Electric utilities are presently compelled to work their framework such that improves use of existing transmission offices. Adaptable AC Transmission System (FACTS) controllers, in light of the quick improvement of energy gadgets innovation, have been proposed as of late for better use of existing transmission offices. With the advancement of FACTS method, it ends up plainly conceivable to expand the power stream controllability and improve control framework's dependability. As of late, Flexible Alternative Current Transmission System (FACTS) controllers have been proposed to upgrade the transient or dynamic steadiness of energy frameworks [2]-[3]. Amid the most recent decade, various control gadgets under the term FACTS innovation have been proposed and actualized. Use of FACTS gadgets in control frameworks, prompts better execution of framework in numerous viewpoints. Voltage strength, voltage direction and power framework dependability, damping can be enhanced by utilizing these gadgets and their appropriate control. There are different types of FACTS gadgets, some of which are associated in arrangement with a line and the others are associated in shunt or a blend of arrangement and shunt. The FACTS innovation is not a solitary high power controller yet rather an accumulation of controllers which can be connected separately or as a team with other to control at least one of the bury related framework parameters like voltage, current, impedance, stage edge and damping of motions at different frequencies beneath the evaluated recurrence. Among all FACTS gadgets, static synchronous compensators (STATCOM) assumes a great deal more vital part in responsive power remuneration and voltage bolster due to its appealing relentless state execution and working qualities.

II. LITERATURE SURVEY

Y. Han, Y. O. Lee [5] presents about Modified non-direct damping of inward progression by means of criticism linearization for static synchronous compensator. The info yield linearization by means of criticism has been connected to STATCOM and it demonstrates uniform transient execution yet attributable to softly damped interior flow it brings about current swells in DC-side capacitors. To diminish the swells, a damping term, time subsidiary of dynamic current duplicated by a consistent pick up, was added to the information yield linearization. An altered non-direct damping controller is proposed to enhance the restriction. The proposed strategy has the damping term with a variable pick up, in this manner gives enhanced transient execution over the entire working extent.

A. Jain, K. Joshi [6] presents about Voltage direction with STATCOMs: Modeling, control and results. This presents framework demonstrating and control plan for quick load voltage direction utilizing static compensators (STATCOMs). The displaying system gives a reasonable portrayal of load voltage size and STATCOM responsive current on a prompt premise. Direct and nonlinear controllers for the direction issue are outlined and thought about through recreation comes about. Inner progression of the STATCOM are demonstrated utilizing a similar procedure. Lyapunov based versatile controllers are intended for controlling the STATCOM receptive current while keeping up its dc transport voltage.

D. Soto and R. Pena [7] present about Nonlinear control procedures for fell multilevel STATCOMs. The procedures rely on upon the control capacity of the converter yield voltage and are appropriate for line recurrence exchanged converters. The principal procedure considers a STATCOM where the voltage is set autonomously of the dc interface voltage. Quick receptive power control inside sub process duration reaction is accomplished. The second methodology is compelled to a voltage whose abundancy stays corresponding to the dc interface voltage.

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G. E. Valdaranna, P. Mattavalli [8] presents about Reactive power and unbalance remuneration utilizing STATCOM with dissipativity based control. This approach depends on a recurrence space displaying of framework elements utilizing positive arrangement and negative succession dynamic parts. The latency based technique, a group of controllers is acquired whose goal is to manage unequal supply voltages, and to perform direction of AC lopsided streams.

C.Hochgraf and R.H.Lasseter,[9] presents about Statcom controls for operation with unequal voltages. In this paper, Statcom need to ready to deal with unequal voltages. A synchronous casing voltage controller is introduced that works notwithstanding when 3phase symmetry is lost. The proposed controller permits the statcom to ride through extreme transient irregularity without detaching from the power framework and to help with rebalancing voltages. The controller keeps up adequate transmission capacity to perform glimmer remuneration.

Mr.M.ChinnaThimmaiah [11] Voltage dependability might be a fundamental idea in up the assurance and responsibility of energy frameworks. The static compensator (STATCOM), a very much preferred gadget for receptive power administration upheld door side road (GTO) thyristors, has picked up a considerable measure of enthusiasm inside the most recent decade for up establishment stability[1]. Inside the past, fluctuated administration ways are made arrangements for STATCOM administration. References [2]–[9] mainly work in the administration style as opposed to investigating an approach to set corresponding essential (PI) administration picks up. In a few STATCOM models, the administration rationale is authorized with the PI controllers. The administration parameters or increases play a key consider STATCOM execution. Directly, few examinations are dispensed inside the administration parameter settings. Inside the [10] PI controller picks up or composed in an exceedingly free examination or experimentation approach with tradeoffs in execution and intensity.

III. THEORETICAL & MATHEMATICAL CONCEPTS

3.1 The Facts controllers:

A power Electronic based system and other static equipment that provide control of one or more AC transmission system parameters. FACTS devices or controllers are used for the dynamic control of voltage, impedance and phase angle of high voltage AC transmission lines. The different main types of FACTS devices are described.

1. Series connected controllers
2. Shunt connected controllers
3. Combined series-series controllers
4. Combined series-shunt controllers

1. SERIES CONNECTED CONTROLLERS:

The series controller could be variable impedance, such as capacitor, reactor etc(or) power electronics based variable source (or) a combination of these. In principle, all series controllers inject voltage in series with the line. The series controller could be variable impedance, such as capacitor, reactor, etc., or power electronics based variable source of main frequency, sub synchronous and harmonic frequencies to serve the desired need. In principle, all series controllers inject voltage in series with the line. Even variable impedance multiplied by the current flow through it, represents an injected series voltage in the line. As long as the voltage is in phase quadrature with the line current, the series controller only supplies or consumes variable reactive power.

- a. Thyristors controlled series capacitor (TCSC)
- b. Thyristor switched series capacitor (TSSC)
- c. Static synchronous series compensator (SSSC)

2. SHUNT CONNECTED CONTROLLERS:

Shunt controllers may be variable impedance, such as capacitor, reactor, etc., or power electronics based variable source, or a combination of these. In principle all shunt controllers inject current into the system at the point of connection. As in the case of series controllers, the shunt controllers may be variable impedance, variable source, or a combination of these. In principle, all shunt controllers inject current into the system at the point of connection. Even variable shunt impedance connected to the line voltage causes a variable current flow and hence represents injection of

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current into the line. As long as the injected current is in phase quadrature with the line voltage, the shunt controller only supplies or consumes variable reactive power.

- a. Static synchronous compensator (STATCOM)
- b. Thyristor controlled reactor (TCR)
- c. Thyristor switched reactor (TSC)
- d. Static var compensator (SVC)

3. COMBINED SERIES-SHUNT CONTROLLERS:

This could be combination of separate shunt and series controllers, which are controlled in a coordinated manner, or a Unified Power Flow Controller with series and shunt elements in principle, combined shunt and series controllers inject current into the system with shunt part of controller and voltage in series in the line with series part of controller. However, when the shunt and series controllers are unified, there can be real power exchange between the series and shunt controllers via the power link. In principle, combined shunt and series controllers inject current into the system with the shunt part of the controller and voltage in series in the line with the series part of the controller. However, when the shunt and series controllers are unified, there can be a real power exchange between the series and shunt controllers via the power link.

4. COMBINED SERIES-SERIES CONTROLLERS:

This could be a combination of separate series controllers, which are controlled in a coordinated manner, in a multiline transmission system. The real power transfer capability of the unified series-series controller, referred to as interline power flow controller, makes it possible to balance both the real and reactive power flow in the lines and thereby maximize the utilization of the transmission system.

3.2 Power system voltage regulation:

If the power voltage becomes unstable, the system voltage will decrease to unacceptable low level and become impossible to recover. Then, the interruption of the power supply will occur in power systems. Therefore, voltage regulation or reactive compensation is an important subject in a power system. Also, it is the utilities' responsibility to keep the customer voltage within specified tolerances. The only way to regulate system voltage is to reduce the reactive power load or install the reactive generation devices at the weak voltage points in the system to increase the voltage at these weak points.

The recent development and use of Flexible Alternating Current Transmission Systems (FACTS) in power systems has led to many applications such as Thyristor Controlled Series Compensator (TCSC), Static Synchronous Series Compensator (SSSC), Static VAR Compensator (SVC), and Static Synchronous Compensator (STATCOM). These devices are not only able improve the voltage stability and provide flexible operation capabilities. However, with the growth of industry and the economy, the demands of lower power losses, faster response to system parameter change, and higher stability margin have become increasingly important. In particular, STATCOMs are one of the most popular devices for voltage regulation because of their constant current characteristics when the voltage is low/high over the limits. STATCOM is a power electronic based synchronous voltage generator that generates a three-phase voltage from a dc capacitor. By controlling the magnitude of the STATCOM voltage and the reactive power exchanges between the STATCOM and the transmission line, the amount of shunt compensation in the power system can be controlled. Therefore, the system voltage will be kept in the allowable range. In this work, the control of STATCOM will be studied.

Voltage control of STATCOM:

Voltage regulation is a critical consideration for improving the security and reliability of power systems. The Static Compensator (STATCOM), a popular device for reactive power control based on gate turn-off (GTO) thyristors, has gained much interest in the last decade for improving power system stability. In the past, various control methods have been proposed for STATCOM control. For instance, nonlinear optimal control to STATCOM is introduced in. A synchronous frame voltage regulator is presented in to control system voltage by using separate regulation loops for positive and negative sequence components of the voltage. PI structures with feed forward are proposed in to improve STATCOM performance. A STATCOM damping controller is introduced in to offset the negative damping effect and

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to enhance system oscillation stability. A modified non-linear damping controller is presented in to provide an improved transient performance over the whole operating range. These previous works mainly focus on the control design rather than exploring how to set PI control gains.

In many STATCOM models, the control logic is implemented with the Proportional-integral (PI) controllers. The control parameters or gains play a key factor in STATCOM performance. Presently, few studies have focused on the control parameter settings. In the previous research works, the PI controller gains were designed in a case-by-case study or trial-and-error approach with tradeoffs in performance and efficiency. It is not feasible for utility engineers to perform trial-and-error studies to find suitable parameters when a new STATCOM is connected to a system. Further, even if the control gains have been tuned to fit the projected scenarios, performance may be disappointing when a change of the system conditions occurs, such as, when a line is upgraded or retires from service.

3.3 The STATCOM Concept:

STATCOM (Static Synchronous Compensator, also known as SVG). It is an important device for Flexible AC Transmission System (FACTS), which is the third generation of dynamic VAR compensation. STATCOM is a shunt device, which uses force-commutated power electronics (i.e. GTO, IGBT) to control power flow and improve transient stability on electrical power networks. Its appearance represents the application of most advanced technology for dynamic VAR compensation. It is also known as DSTATCOM when apply in power distribution. STATCOM is connected parallel in power grid and works as reactive current source. Its reactive current can be flexibly controlled and compensate reactive power for system automatically. It solves problem of harmonics interfere switching parallel capacitor banks. In another hand, it can restrain harmonics and improve power quality according to customers' needs. STATCOM has superior performance in lots of aspect such as responding speed, stabilize voltage of power grid, reduce system power loss and harmonics, increase both transmission capacity and limit for transient voltage. It also has advantage of smaller in dimension.

A STATCOM is a regulating device used on alternating current electricity transmission network. It is based on power electronics VSC & can act as either a source or sink of reactive ac power to an electricity network. It is member of the facts family of devices. STATCOM is a FACTS controller that is used in power systems to regulate the line voltage, enhance the power transmission capacity and extend the transient stability margin. STATCOM is conventionally realized by a voltage-source converter; however, being a current injection device, its performance can be improved when realized by a current-source converter (CSC) that can generate a controllable current directly at its output terminals. STATCOM has a VSC (Voltage Source Converter) interface, and the DC-voltage support is provided with capacitors of relatively small energy storage, so the active power exchange is zero in steady-state. In practice there will be a little active power interchange due to losses. The basic principle of operation for the STATCOM is to compare the voltage in the system and the terminal voltage on the VSC, and control the phase angle and amplitude on the voltage drop over the transformer inductance. When the voltage in the electric system is lower than the terminal voltage on the VSC, the STATCOM will generate reactive power, the STATCOM works in capacitive mode. If the voltage on the VSC is lower than the voltage in the electric network, the STATCOM will absorb reactive power, the STATCOM works in inductive mode. If the voltage of the electric network and the terminal voltage on the VSC are equal, there will not be any reactive flow in the STATCOM.

The STATCOM is normally designed to provide fast voltage control to enhance the stability of system. Two basic controls are implemented in a STATCOM. The first is the AC voltage regulation across the grid and second one is the control of the DC voltage across the capacitor. By using the above controller the active power injection from the STATCOM to the grid is being controlled. Conventionally PI controllers have been use as regulates of STATCOM. Conventional PI controller has limitation over its operating range. It is highly inefficient during nonlinear operations. The STATCOM has several advantages including fast response, continuous and quick control of reactive power, and smaller storage capacitance. In addition, the ability of the reactive power compensation in STATCOM is better than SVC. The STATCOM basically performs the same function as the static var compensators but with some advantages. The term Static Synchronous Compensator is derived from its capabilities and operating principle, which are similar to those of rotating synchronous compensators (i.e. generators), but with relatively faster operation.

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3.4 STATCOM Operating Principle:

The STATCOM generates a balanced 3-phase voltage whose magnitude and phase can be adjusted rapidly by using semiconductor switches. The STATCOM is composed of a voltage-source inverter with a dc capacitor, coupling transformer, and signal generation and control circuit. The voltage source inverter for the transmission STATCOM operates in multi-bridge mode to reduce the harmonic level of the output current. Fig. below shows a single-phase equivalent circuit in which the STATCOM is controlled by changing the phase angle between the inverter output voltage and the bus voltage at the common point connection point.

The inverter voltage V_i is assumed to be in phase with the ac terminal voltage V_t . The STATCOM supplies reactive powers to the ac system if the magnitude of V_i is greater than that of V_t . It draws reactive power from the ac system if the magnitude of V_t is greater than that of V_i . There can be a little active power exchange between the STATCOM and the EPS. The exchange between the inverter and the AC system can be controlled adjusting the output voltage angle from the inverter to the voltage angle of the AC system. This means that the inverter cannot provide active power to the AC system form the DC accumulated energy if the output voltage of the inverter goes before the voltage of the AC system. On the other hand, the inverter can absorb the active power of the AC system if its voltage is delayed in respect to the AC system voltage. Using the classical equations that describe the active and reactive power flow in a line in terms of V_i and V_s , the transformer impedance (which can be assumed as ideal) and the angle difference between both bars, we can define P and Q.

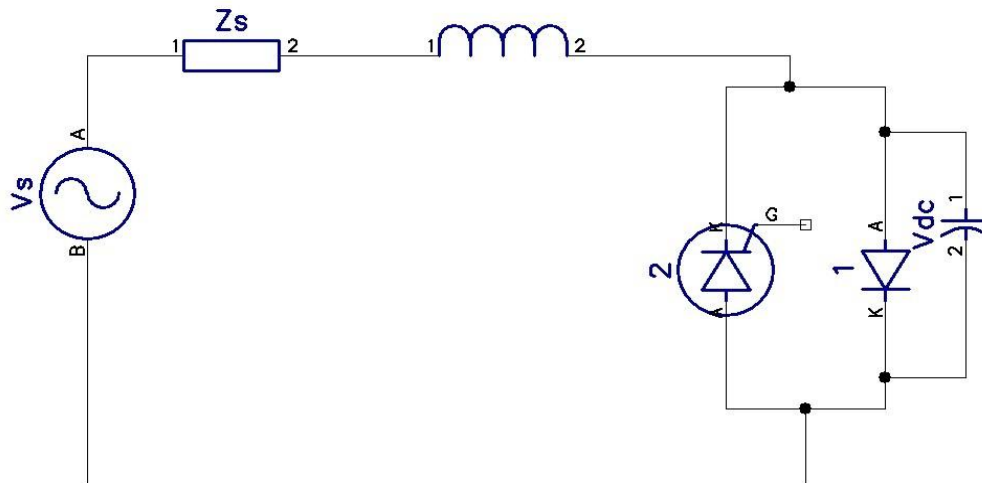


Fig. 3.1 Single phase equivalent circuit of STATCOM

The angle between the V_s and V_i in the system is δ . When the STATCOM operates with $\delta=0$ we can see how the active power send to the system device becomes zero while the reactive power will mainly depend on the voltage module. This operation condition means that the current that goes through the transformer must have a $\pm 90^\circ$ phase difference to V_s . In other words, if V_i is bigger than V_s , the reactive will be send to the STATCOM of the system (capacitive operation), originating a current flow in this direction. In the contrary case, the reactive will be absorbed from the system through the STATCOM (inductive operation) and the current will flow in the opposite direction. Finally if the modules of V_s and V_i are equal, there won't be nor current nor reactive flow in the system. Thus, we can say that in a stationary state Q only depends on the module difference between V_s and V_i voltages. The amount of the reactive power is proportional to the voltage difference between V_s and V_i .

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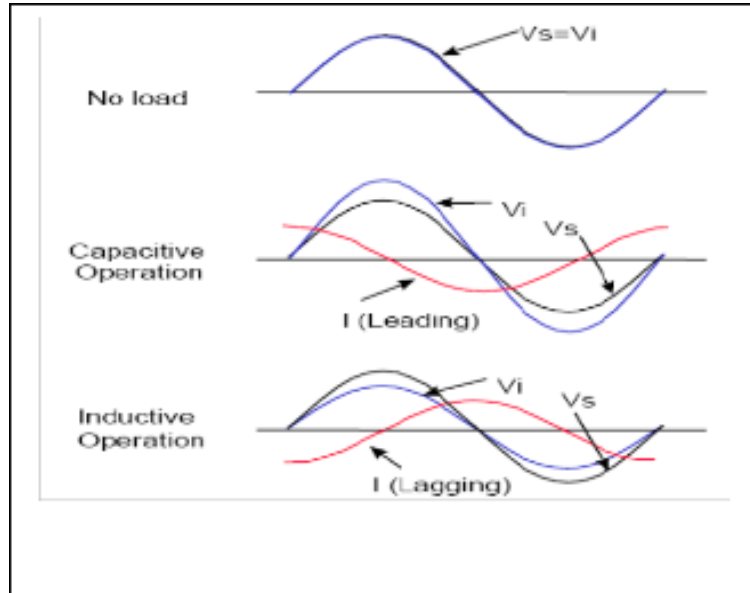


Fig. 3.2 Operating Principle of STATCOM

3.5 Equivalent circuit of Statcom:

The fundamental principle of a STATCOM installed in a power system is the generation ac voltage source by a voltage source inverter (VSI) connected to a dc capacitor. The active and reactive power transfer between the power system and the STATCOM is caused by the voltage difference across the reactance. The STATCOM can also increase transmission capacity, damping low frequency oscillation, and improving transient stability.

The PI controller gains are designed in a case-by-case study or trial-and-error approach with tradeoffs in performance and efficiency. Performance may be disappointing when a considerable change of the system conditions occurs. The situation can be even worse if such transmission topology change is due to a contingency. Thus, the STATCOM control system may not perform well when mostly needed. Motivation of this project is to propose a control method that can ensure a quick and consistent desired response when the system operation condition varies. In other words, the change of the external condition will not have a negative impact, such as slower response, overshoot, or even instability to the performance. Base on this fundamental motivation, an adaptive PI control of STATCOM for voltage regulation is presented.

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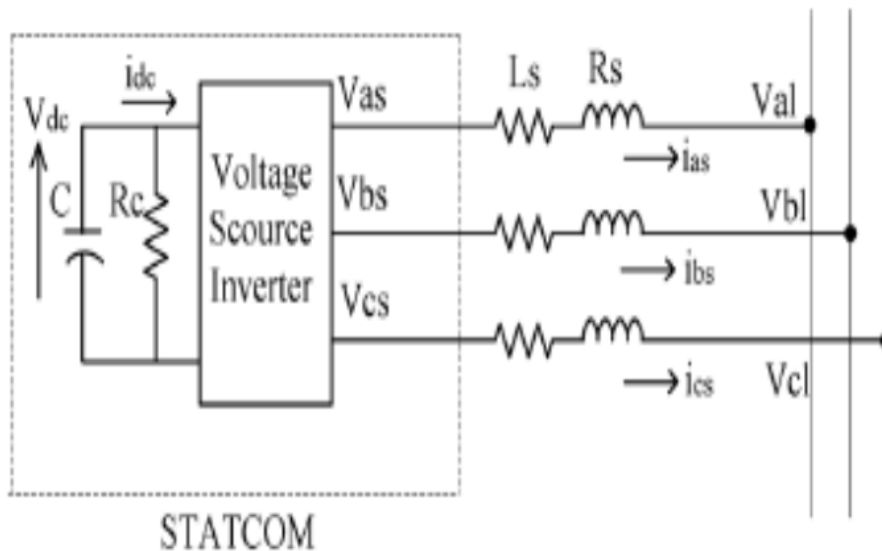


Fig.3.3. Equivalent circuit of STATCOM

The equivalent circuit of the STATCOM is shown in Figure. In this power system, the resistance R_s in series with the voltage source inverter represents the sum of the transformer winding resistance losses and the inverter conduction losses. The inductance L_s represents the leakage inductance of the transformer. The resistance R_c in shunt with the capacitor C represents the sum of the switching losses of the inverter and the power losses in the capacitor. In Figure shows, V_{as} , V_{bs} , and V_{cs} are the three-phase STATCOM output voltages; V_{al} , V_{bl} , and V_{cl} are the three phase bus voltages; i_{as} , i_{bs} , and i_{cs} are the three-phase STATCOM output currents.

The static compensator (STATCOM), a popular device for reactive power control based on gate turnoff (GTO) thyristors, has gained much interest in the last decade for improving power system stability. Various control methods have been proposed for STATCOM control. References [4]-[8] mainly focus on the control design rather than exploring how to set proportional-integral (PI) control gains. In many STATCOM models, the control logic is implemented with the PI controllers. The control parameters or gains play a key factor in STATCOM performance.

3.6 Block Diagram:

The STATCOM with fixed PI control parameters may not reach the desired and acceptable response in a power system when the power system operating condition changes. An adaptive PI control method is presented in this section in order to obtain the desired response and to avoid performing trial-and-error studies to find suitable parameters for PI controllers when a new STATCOM is installed in a power system. With this adaptive PI control method, the dynamical self-adjustment of PI control parameters can be realized.

An adaptive PI control block for STATCOM is shown in Figure. In Figure, the measured voltage $V_m(t)$ and the reference voltage $V_{ref}(t)$, the q-axis reference current I_{qref} and the q-axis current I_q are in per unit values. The proportional and integral parts of the voltage regulator gains are denoted by K_{p_V} and K_{i_V} , respectively. Similarly, the gains K_{p_I} and K_{i_I} represent the proportional and integral parts, respectively, of the current regulator. In this control system, the allowable voltage error K_d is set to 0. The K_{p_V} , K_{i_V} , K_{p_I} and K_{i_I} can be set to an arbitrary initial value such as simply 1.0.

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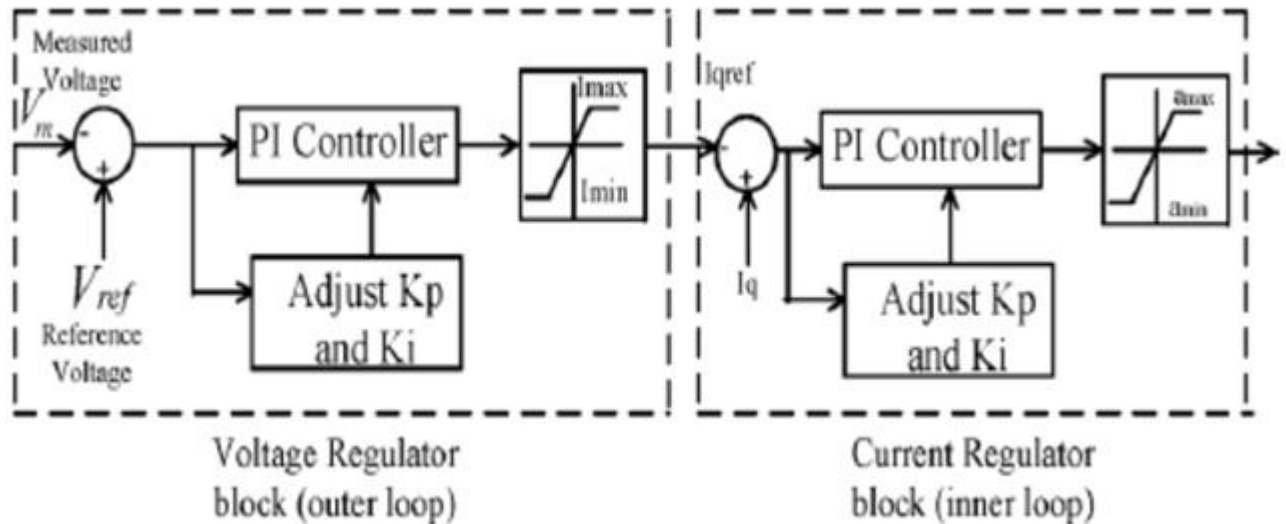


Fig.3.4 Adaptive PI control block for STATCOM

The process of the adaptive voltage-control method for STATCOM is described as follows.

- 1) The bus voltage $V_m(t)$ is measured in real time.
- 2) When the measured bus voltage over time $V_m(t) \neq V_{ss}$, the target steady-state voltage, which is set to 1.0 per unit(p.u.) in the discussion and examples, $V_m(t)$ is compared with V_{ss} . Based on the desired reference voltage curve, $K_{p,v}$ and $K_{i,v}$ are dynamically adjusted in order to make the measured voltage match the desired reference voltage, and the q-axis reference current I_{qref} can be obtained.
- 3) In the inner loop, I_{qref} is compared with the q-axis current I_q . Using the similar control method like the one for the outer loop, the parameters $K_{p,v}$ and $K_{i,v}$ can be adjusted based on the error. Then, a suitable angle can be found and eventually the dc voltage in STATCOM can be modified such that STATCOM provides the exact amount of reactive power injected into the system to keep the bus voltage at the desired value. It should be noted that the current I_{max} and I_{min} and the angle α_{max} and α_{min} are the limits imposed with the consideration of the maximum reactive power generation capability of the STATCOM controlled in this manner. If one of the maximum or minimum limits is reached, the maximum capability of the STATCOM to inject reactive power has been reached.

3.7 Advantages of Statcom:

The development of Statcom is very promising for the electric energy industry because of the following advantages:

1. Continuous and dynamic voltage control
2. High dynamic and very fast response time
3. Enables grid code compliance
4. Maximum reactive current over extended voltage range
5. High efficiency
6. Single phase control for unbalanced loads
7. Faster response, Requires less space as bulky passive components
8. It can be interfaced with real power sources such as battery, fuel cell or SMES (superconducting magnetic energy storage)
9. A STATCOM has superior performance during low voltage condition as the reactive current can be maintained constant. It is even possible to increase the reactive current in a STATCOM under transient conditions if the devices are rated for the transient overload

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IV. SIMULATION RESULTS

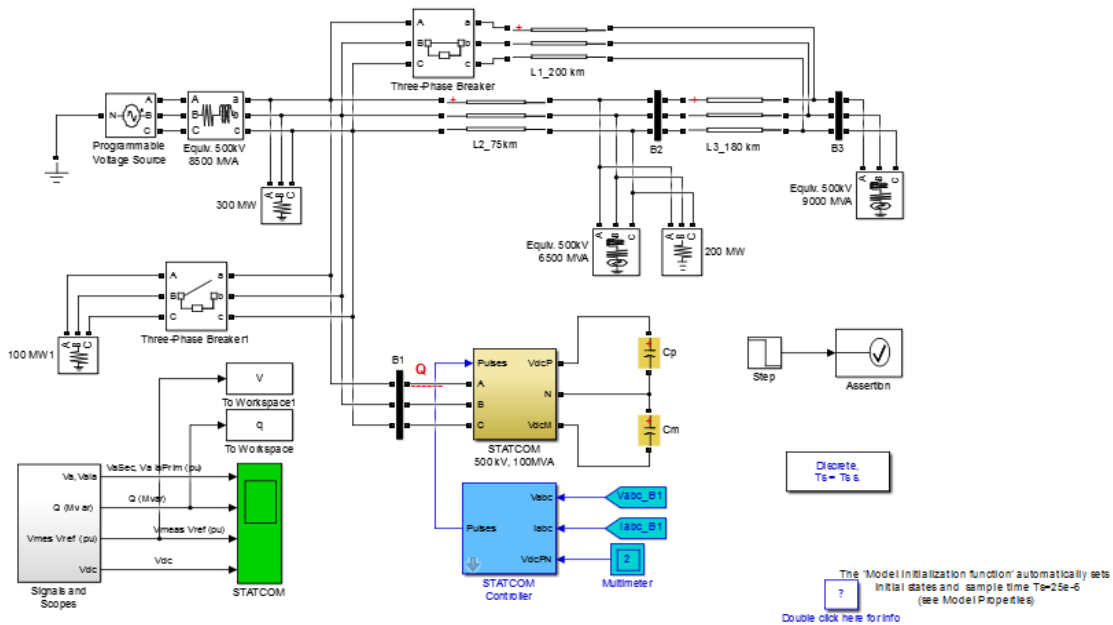


Fig 4.1 Simulation of STATCOM

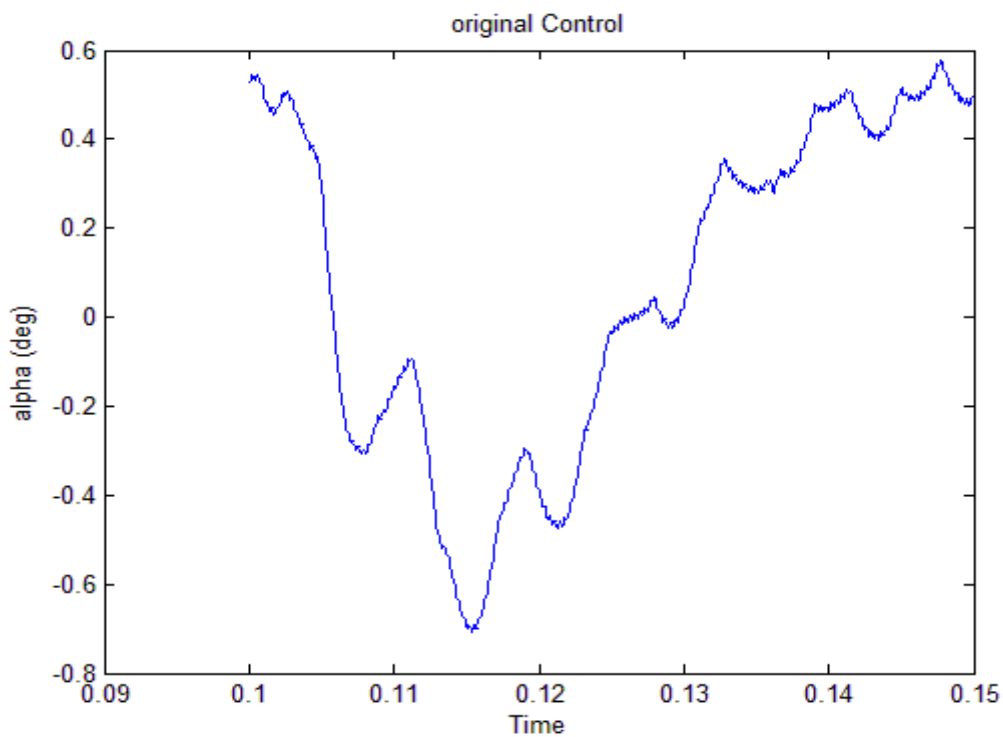


Fig4.2alpha_original

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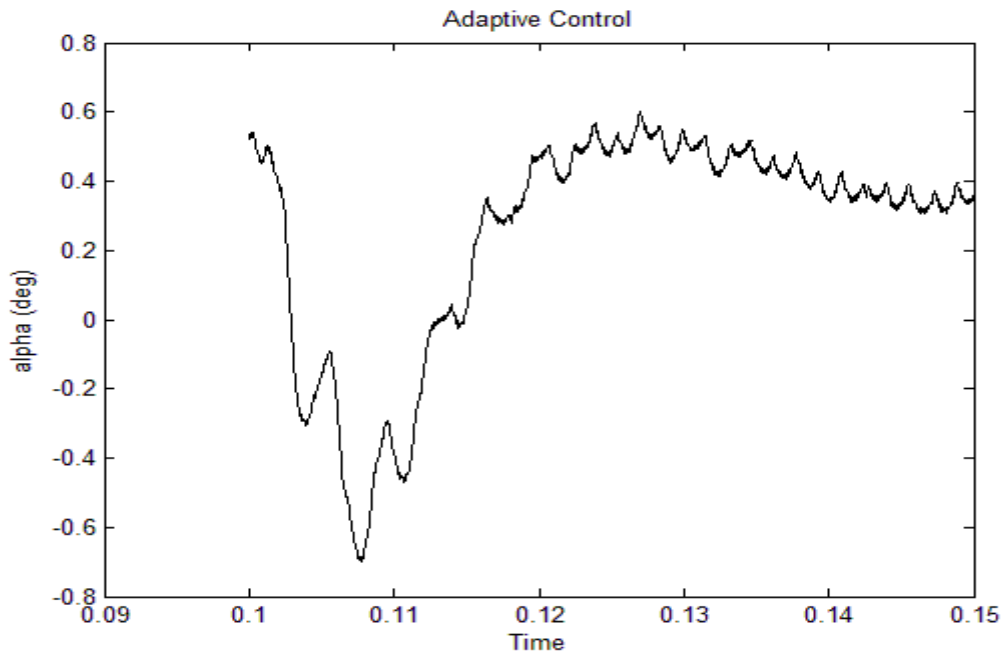


Fig 4.3alpha_adaptive

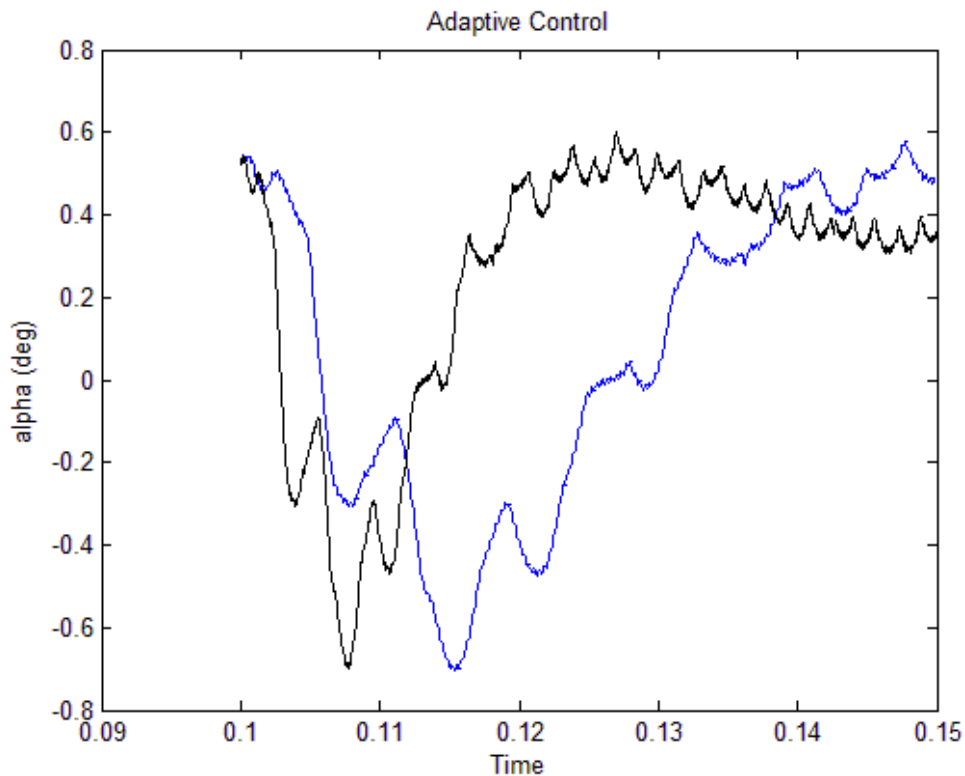


Fig4.4alpha_combined

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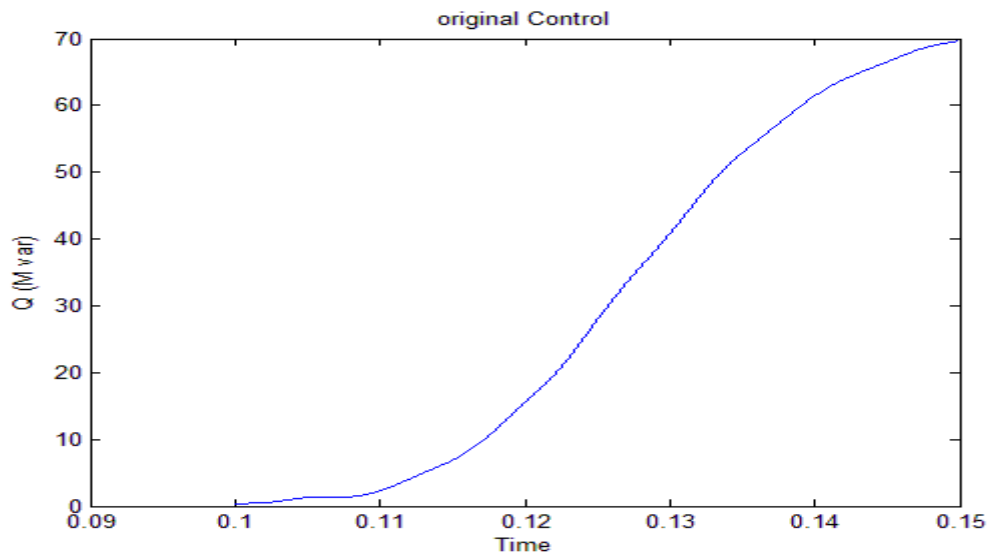


Fig4.5q_original

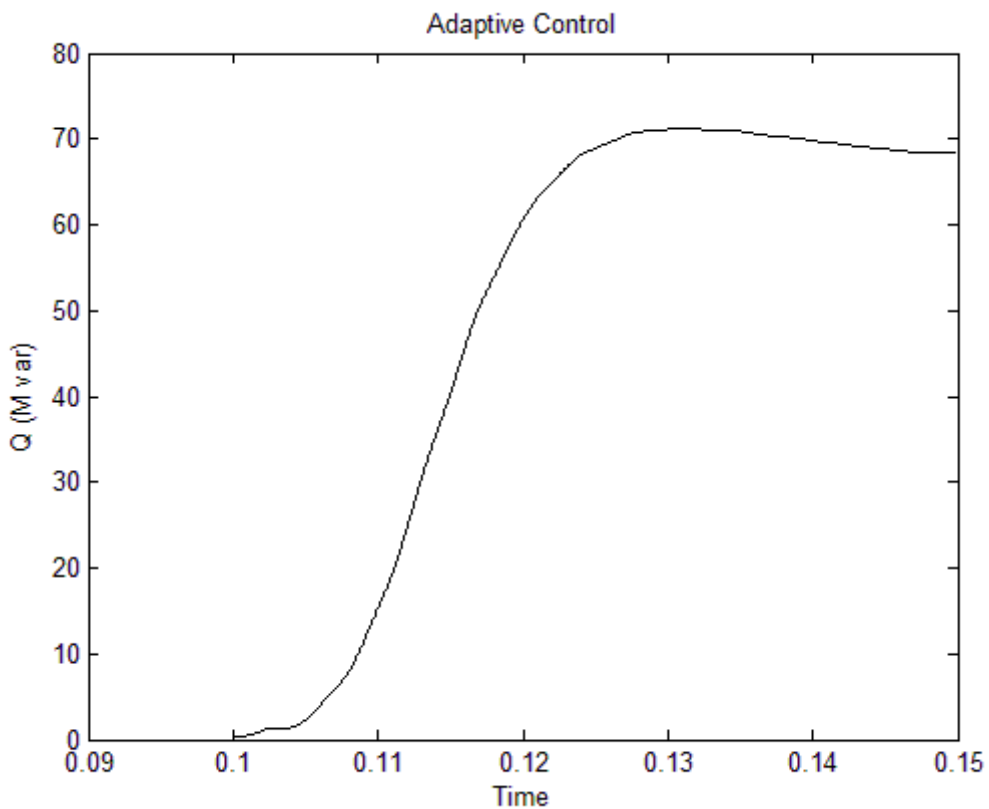


Fig4.6q_adaptive

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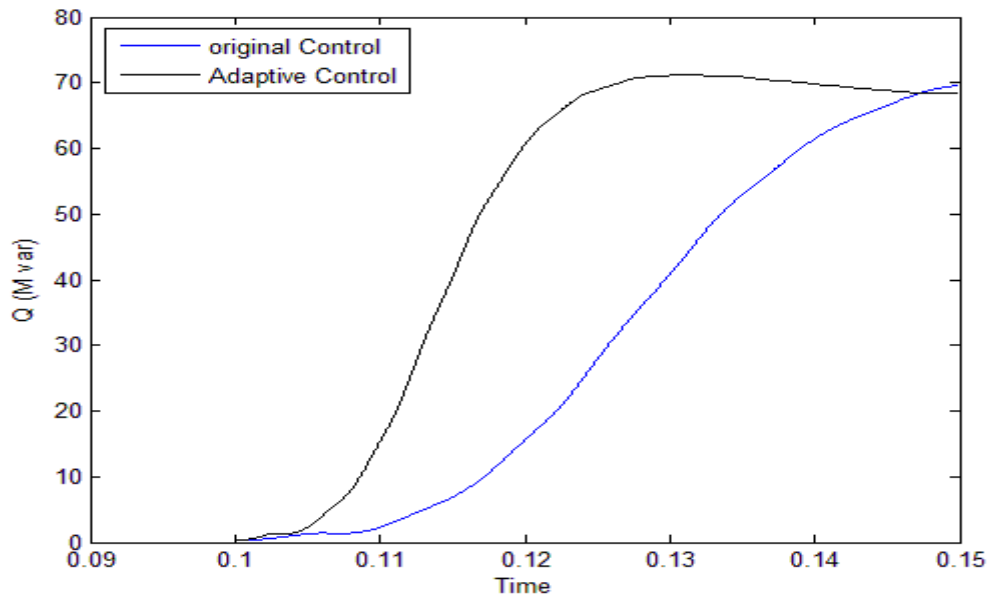


Fig4.7q_Combined

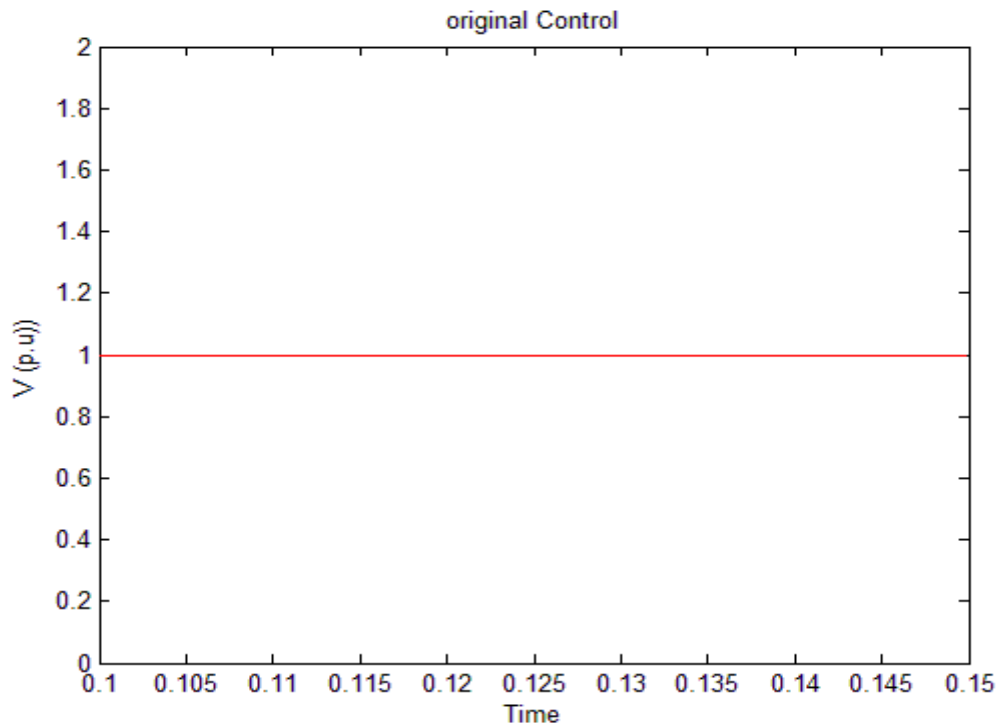


Fig4.8V_original

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V. CONCLUSION

Different STATCOM control strategies have been checked on including numerous uses of PI controllers. In any case, these past works get the PI picks up by means of an experimentation approach or broad examinations with a tradeoff of execution and materialness. Subsequently, control parameters for the ideal execution at a given working point may not be powerful at an alternate working point. To address the test, this work proposes another control demonstrate in view of versatile PI control, which can self-alter the control picks up powerfully amid an aggravation with the end goal that the execution dependably coordinates a coveted reaction, paying little mind to the change of the working condition. Since the alteration is self-ruling, this gives the "attachment and-play" capacity for STATCOM operation. In the reproduction contemplate, the proposed versatile PI control for STATCOM is contrasted and the ordinary STATCOM control with pre-tuned settled PI additions to confirm the benefits of the proposed technique. The outcomes demonstrate that the versatile PI control gives reliably incredible execution under different working conditions, for example, extraordinary introductory control increases, diverse load levels, changes of transmission arrange, sequential unsettling influences and an extreme aggravation. Interestingly, the traditional STATCOM control with settled PI increases may perform worthy in the first framework, however may not execute as productively as the proposed control technique when there is a change of the framework conditions. From the above examinations, it is obvious that the versatile PI control can accomplish quicker and more reliable reaction than the first control. The reaction time and the bend of the proposed versatile PI control is practically indistinguishable under different conditions. Interestingly, the reaction bend of the first control display differs enormously under a change of framework working conditions and may neglect to revise the voltage to the normal esteem. The upside of the proposed versatile PI control approach is normal in light of the fact that the control picks up are progressively and self-rulingly balanced amid the voltage remedy prepare, in this way, the coveted execution can be accomplished.

VI. FUTURE SCOPE

1. Provides fast smooth dynamic compensation from inductive to capacitive in reactive power. Also reactive power delivery to the power grid. It meets the maximum request to compensate power factor, keeps power factor close to 1.0 at any time.
2. It has low power loss, better economical operation.
3. It has powerful ability to support voltage and ability to withstand short-time overload.
4. It has faster response time and better effect for restraining flicker.
5. Produce no harmonic and filtering partial load harmonic without amplifying harmonic and no harmonic resonance. It has better safety and stability due to it is not sensitive to the system parameters.
6. Modules designed, easy for installation and maintenance, high reliability with parallel converter design & modular construction.
7. It has less space for installation, also provides flexible installation, compact size.
8. It has low loss and low noise.

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